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Fish Consumption Pattern and Nutritional Awareness Among the Population of Sitamarhi District of Bihar, India

Ved Prakash Dubey[1&2]* and Sunny Raj[1]

[1]Post Graduate Department of Zoology, Sri Radha Krishna Goenka College, Sitamarhi, Bihar, India;
[2]Post Graduate Department of Zoology, Langat Singh College, Muzaffarpur, Bihar, India

E-mail/Orcid Id:

VPD, veddubey9184@gmail.com, https://orcid.org/0009-0007-7845-0107; *SR,* sunnyrajstm1357@gmail.com, https://orcid.org/0009-0006-6574-6120

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Abstract: Fish play a vital role in ensuring food and nutritional security by providing high-quality protein, essential fatty acids, vitamins, and minerals. Despite Bihar's rich inland water resources, per capita fish consumption remains lower than the national average. This study aimed to assess fish consumption patterns, preferred species, and nutritional awareness among residents of Sitamarhi district, Bihar, India. A descriptive cross-sectional survey was conducted from July 2024 to March 2025 using a structured Google Forms questionnaire administered to 120 respondents, including students, professionals, and fish vendors. Data on socio-demographic profiles, dietary preferences, frequency of fish consumption, species choice, and awareness of nutritional benefits were collected. Additionally, field visits and market observations were conducted in major fish trading hubs such as Bazar Samiti, Gudri Bazar, Kargil Chowk, Bathnaha Bazar and Dumra. Quantitative data were analyzed using Microsoft Excel, and results were presented using descriptive statistics, tables, and figures. Among respondents, 78% were non-vegetarian, of whom 72% consume fish. Weekly consumption was most common (37.2%), followed by occasional (33.9%) and rare (28.9%) intake. Rohu (*Labeo rohita*, 20%), Bhakura (*Catla catla*,18%), Gaicha (*Mastacembelus pancalus*, 16 %) and Bighat (*Hypophthalamichthyes molitrix,* 12 %) were the most preferred species. While 85% of fish consumers recognized its role in brain health, fewer were aware of its cardiovascular and immune system benefits. Seasonal availability, religious fasting, and affordability significantly influenced consumption trends. Most consumers (72%) purchased fish from markets, with a smaller proportion sourcing from local ponds or farms. Fish is a culturally valued and widely consumed protein source in Sitamarhi, but comprehensive nutritional awareness remains limited. Enhancing public education, strengthening cold chain infrastructure, and promoting sustainable aquaculture could significantly improve fish consumption and rural livelihoods in the district.

Introduction

Fish is a nutrient-dense food providing high-quality protein, essential amino acids, omega-3 fatty acids, vitamins (A, D, B-complex) and minerals such as calcium, phosphorus, iron, zinc and iodine (Mohanty et al., 2014; Badoni et al., 2021; Byrd et al., 2021; Maulu et al., 2021; Ahmed et al., 2022; Noreen et al., 2025). Regular fish consumption is associated with improved cardiovascular health, enhanced brain function, and reduced risk of chronic diseases (Gebauer et al., 2006; Mozaffarian et al., 2011; Rizos et al., 2012; Abu-Ouf et al., 2014; Tørris et al., 2018; Abdelhamid et al., 2018; Mohan et al., 2021; Spiller et al., 2025). Fish and fish-based products are widely regarded as among the healthiest food options available, offering high nutritional value with minimal environmental impact. Due to these benefits, they are essential components in national, regional, and global strategies aimed at enhancing food security and nutrition. Additionally, fish play a critical role in the effort to reshape food systems and combat hunger and malnutrition. Globally, fish contribute significantly to dietary needs, providing nearly 20% of the average per capita animal protein intake for around 3.3 billion people (Boyd et al., 2022). In 2017, fish made

*Corresponding Author: veddubey9184@gmail.com

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up approximately 17% of the total animal protein consumed and about 7% of all protein intake worldwide (Boyd et al., 2022).

Inland fisheries play a crucial role in India's fisheries sector, significantly supporting the national economy and ensuring livelihoods for millions of people, and produce ~70% of total fish production (Villanthenkodath and Pal, 2025). As the world's second-largest fish-producing nation, India depends greatly on its inland water resources. The country is endowed with a wide array of inland fisheries, including approximately 0.28 million kilometers of rivers and canals, lakes and floodplain (1.25 million hectares), ponds and tanks (2.45 million hectares), and reservoirs (3.15 million hectares). These extensive resources form the core of India's fisheries development, positioning the nation as the second-largest aquaculture producer globally.

Bihar holds a unique potential in tackling its nutritional challenges through the effective use of its numerous ponds and water bodies. These aquatic resources provide an excellent opportunity to develop small-scale fisheries, which can not only boost rural livelihoods but also play a key role in improving food security and reducing malnutrition. Despite this potential, fish consumption in Bihar remains significantly lower than both national and global averages. According to estimates from the OECD and FAO (2019–20), the global average consumption of fish is 20.5 kg per capita, while Bihar lags behind at just 9.6 kg per person (Bhushan & Shukla, 2024). This is particularly concerning given the high nutritional value of fish, which is a rich source of quality protein, omega-3 fatty acids, and essential vitamins and minerals (Mohanty et al., 2014; Badoni et al., 2021; Byrd et al., 2021; Maulu et al., 2021; Ahmed et al., 2022). Sitamarhi district, located along the Indo-Nepal border in Northern Bihar, has abundant inland water bodies including rivers such as the Bagmati, Lakhandei and Adhwara group tributaries (Ground Water Information Booklet, 2009). Despite this potential, local fish consumption is influenced by socio-cultural practices, seasonal availability, market infrastructure, and public awareness. Religious fasting periods, cultural dietary restrictions, and affordability are known to cause fluctuations in consumption.

In recent years, lifestyle changes and the growing popularity of processed and fast foods have contributed to declining consumption of traditional nutrient-rich foods like fish in rural, urban and semi-urban populations (Dittrich, 2009; Kumar et al., 2022; Yousefian et al., 2022; Choithani et al., 2023). This dietary shift poses risks of protein deficiency and related health concerns (Swaminathan et al., 2012; Ritchie et al., 2018; Jain et al., 2023; Drewnowski, 2023; Drewnowski & Hooker, 2025; Kumar et al., 2025; Maleky & Ahmadi, 2025). Moreover, limited awareness of the full nutritional value of fish further restricts its dietary role in some communities.

Previous studies in Bihar have primarily focused on fish production and marketing, with limited emphasis on

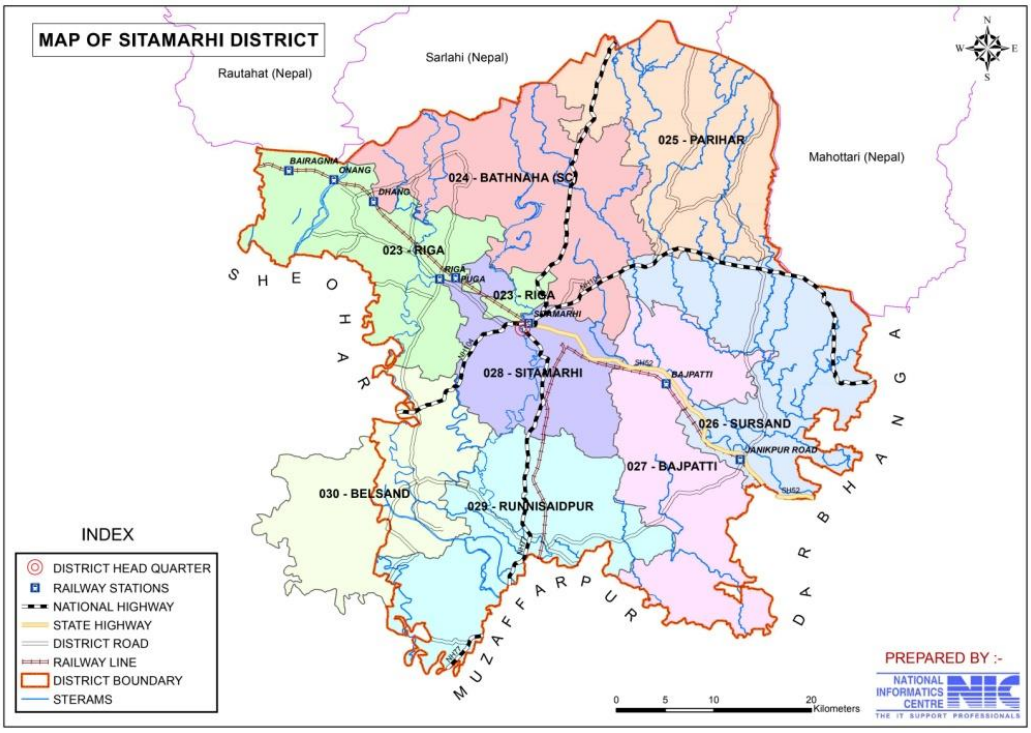

Figure 1. Map of Sitamarhi District.

consumption behaviour and nutritional awareness at the district level (Kumar & Dhande, 2023; Sridevi et al., 2024). Therefore, this study aims to fill that gap by:

1. Assessing the prevalence and frequency of fish consumption in Sitamarhi
2. Identifying preferred fish species and sources;
3. Evaluating public awareness of fish-related nutritional benefits; and
4. Understanding socio-cultural and seasonal factors influencing consumption.

The findings are expected to support policymakers, nutritionists, and fisheries development programmes in designing interventions that improve both dietary quality and rural economic sustainability.

Materials and Methods

Study Area

The study was conducted in Sitamarhi district, Bihar, India, located between 26°35′N latitude and 85°30′E longitude, sharing its northern boundary with Nepal and surrounded by Sheoher in the West, Darbhanga in the East and Muzaffarpur in the South (Fig 1). The Sitamarhi is endowed with a dense network of rivers, ponds, and wetlands, including the Bagmati, Lakhandei and Adhwara group tributaries, which provide a suitable environment for freshwater fisheries (https://dcmsme.gov.in/dips/SITAMARHI-DIPS.pdf.) The district has a population of 3.42 million, of which 94.44% reside in rural areas (https://sitamarhi.nic.in/demography/)

Study Design and Sampling

A descriptive cross-sectional survey was undertaken from July 2024 to March 2025 to assess fish consumption patterns, preferred species, and nutritional awareness. A purposive sampling method was used to recruit 120 respondents, comprising students, working professionals, and fish vendors across both urban (58%) and rural (42%) areas.

Data Collection

Primary data were collected using a structured questionnaire designed in Google Forms, which included both closed- and open-ended questions on demographic profile, dietary preferences, frequency and quantity of fish consumption, preferred fish species, purchasing sources, and nutritional knowledge (https://docs.google.com/forms/d/e/1FAIpQLSd1vzLr0ZSbQUH-IGOAL0TUyb2CSvjcx-JSQw6tKTdoNi_hEw/viewform?usp=dialog).

The questionnaire link was shared via WhatsApp, email and in-person interactions, supplemented by interviews with 12 fish retailers and 8 fish farmers (Fig. 2–8). The tool was pre-tested for clarity and revised before final distribution.

In addition to the survey, field observations were conducted in major fish markets, Bazar Samiti, Gudri Bazar, Adarsh Nagar, Bathnaha Bazar and Dumra, to record seasonal availability, price fluctuations, and species diversity. Photographs were taken with respondent consent for documentation purposes (Representative Photographs are shown in Figure 2-8).

Figure 2. Fish Retailer at Adarsh Nagar Sitamarhi.

Figure 3. Fish Retailer at Gudri Bazar Sitamarhi.

Figure 4. Fish Retailer at Gaushala Chowk, Sitamarhi.

Figure 5. Fish Retailer at Bathanaha Bazar, Sitamarhi.

Figure 6. Village fish seller at Bathnaha Sitamarhi.

Figure 7. Fish Retailer at Adarsh Nagar, Sitamarhi.

Figure 8. Fish Retailer at Bhavdepur Gumti, Sitamarhi.

Data Analysis

Survey responses were compiled in Microsoft Excel and analyzed using descriptive statistics such as frequency and percentage. Graphs and charts were generated to illustrate findings on consumption frequency, species preference, and reasons for fish avoidance.

Ethical Considerations

All the respondents participated willingly, and their consent was obtained. No personal identifiers were disclosed. The study adhered to ethical guidelines for social science research involving human participants.

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Results and Discussion

Area of Residence

The Survey on fish consumption patterns and nutritional awareness among the population of Sitamarhi, Bihar, India was carried out. A total of 120 respondents were surveyed, 58% resided in urban areas and 42% in rural areas (Fig. 9). This balanced distribution allowed for a fair comparison between the two groups. Urban respondents reported greater access to diverse fish species through established markets, while rural respondents frequently sourced fish from local ponds or community-based aquaculture units.

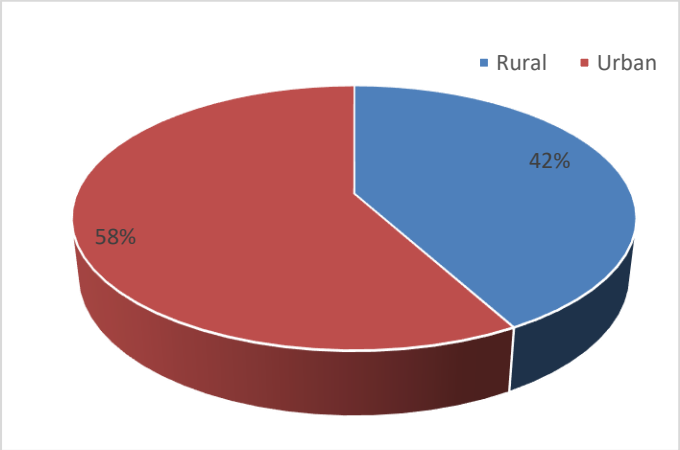

Figure 9. Locality of Respondents.

Dietary Preferences

Overall, 78% of participants were non-vegetarians, while 22% identified as vegetarians. Among the non-vegetarians, 72% consumed fish (Fig. 10). The remaining 28% abstained, citing reasons such as religious or cultural restrictions, dislike of taste or smell, allergic reactions, and affordability issues. Similar patterns of fish avoidance have been documented in other regions of India where socio-cultural norms strongly influence dietary behaviour.

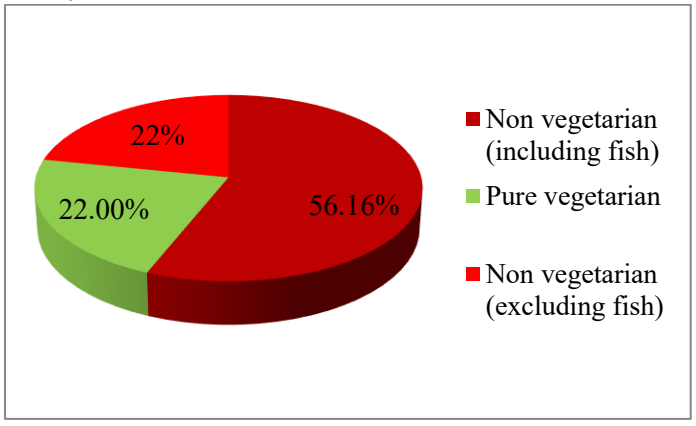

Figure 10. Dietary Preferences of respondents.

Frequency of Fish Consumption

Weekly consumption was the most common pattern (37.2%), followed by occasional (33.9%) and rare consumption (28.9%). Urban households were more likely to consume fish weekly, aided by better infrastructure for storage and transportation. In rural households, irregular consumption was often linked to seasonal availability and local production cycles.

Sources of Fish

The majority of fish consumers (72.1%) obtained fish from local markets, 25.6% sourced it directly from ponds or farms, and 2.3% used alternative sources (Fig. 11). Prominent markets such as Bazar Samiti, Gudri Bazar, and Kargil Chowk functioned as central distribution hubs for both farmed and imported fish species.

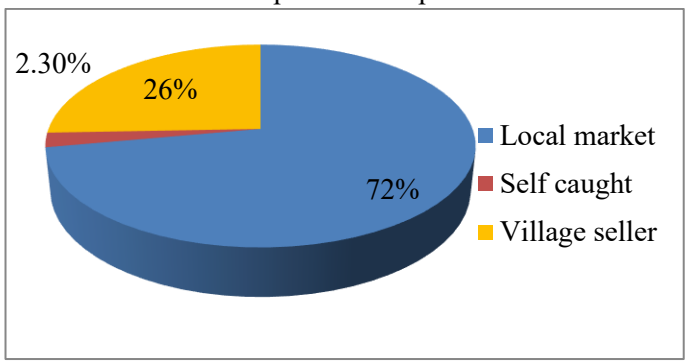

Figure 11. Fish procurement locations.

Preferred Fish Species

Survey data indicated a strong preference for Rohu (*Labeo rohita*) at 20 %, followed by Bhakura (*Catla catla*) at 18% and Gaicha (*Mastacembelus pancalus*) at 16% (Fig.12). Indigenous varieties such as Buari (*Wallago attu*) and Bachwa (*Puntius sophore*) were also valued, particularly in rural areas, due to their taste and cultural significance. Price sensitivity was a major factor in species selection, with premium species like Gaicha commanding higher market rates.

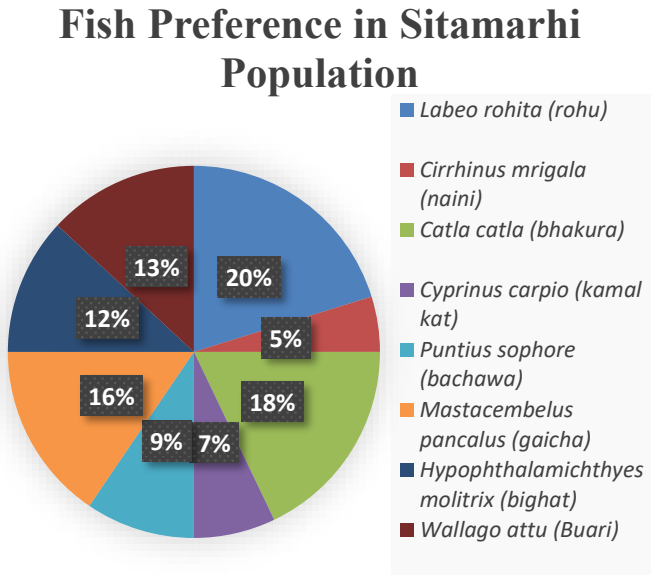

Figure 12. Preferred fish species in Sitamarhi Population.

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Alternative Protein Sources

Among respondents who did not consume fish, common protein sources included pulses, soy products, dairy products, and eggs. Some urban respondents also reported the use of protein supplements. This substitution behaviour aligns with broader dietary adaptation strategies in areas with limited or irregular fish consumption.

Seasonal Variations in Demand

Fish consumption exhibited clear seasonal trends. The highest demand occurred in winter (November–February), attributed to favourable weather conditions for storage and preparation. Summer months (April–June) saw moderate consumption, while the monsoon season (July–September) experienced fluctuating demand due to variable supply from flooded ponds and rivers. Cultural and religious observances, such as Chhath, Navratri, and Makar Sankranti, caused temporary but significant declines in consumption. A weekly dip in sales was also observed on Tuesdays and Thursdays, driven by local dietary customs.

Market Observations

Field visits confirmed a consistent supply of Indian major carps — Rohu, Catla and Bighat in all major markets. Indigenous species like Gaicha and Buari were available in smaller quantities and fetched higher prices due to perceived superior taste and nutritional value. Price disparities between rural and urban markets were evident, largely due to differences in transportation costs, market fees, and intermediary margins.

Challenges in Fish Farming

In interviews with local fish farmers (Fig. 13) following challenges were manifested among farmers. There is limited awareness of scientific aquacultural practices among the farmers. Farmers face problems in fish disease management due to inadequate help and consultations from scientists and the district fishery department. Most of the aquaculture ponds also face a seasonal drought period, leading to pond drying. Facilities for the storage of caught fish and refrigerated transport are also lacking, which hampers the reach of quality fish from the field to the markets. Most of the farmers are dependent on the supply of fish seed from hatcheries in neighbouring districts Muzaffarpur, Darbhanga and Bhagalpur. Weak cooperative marketing structures also affect overall freshwater fisheries in Sitamrahi.

These findings echo challenges reported in other inland fishing regions of India, underscoring the need for targeted interventions in infrastructure, training and cooperative development.

Figure 13. Interviews with local fish farmers.

The results indicate that while fish consumption is culturally embedded in Sitamarhi, awareness of its full nutritional benefits remains limited. This mirrors observations from similar studies in other non-coastal districts, where socio-cultural traditions, economic capacity, and infrastructure constraints jointly shape consumption patterns. Addressing these gaps through nutritional education, market improvements, and community-level aquaculture promotion could significantly enhance both dietary quality and rural income generation.

Conclusion

This study provides a comprehensive overview of fish consumption patterns and nutritional awareness in Sitamarhi district, Bihar. The findings confirm that fish is an integral component of the local non-vegetarian diet, with Indian major carps such as Rohu (*Labeo rohita, 20%*), Catla (*Catla catla,* 18%), Gaicha (*Mastacembelus pancalus*, 16%) and Bighat (*Hypophthalamicthyes molitrix,* 12%) being the most preferred species. Indigenous varieties also hold cultural and culinary value but face availability constraints.

While consumption rates are high among non-vegetarians, nutritional awareness beyond brain health benefits remains limited. Factors such as seasonal availability, religious fasting, affordability, and market accessibility significantly influence consumption frequency and species choice.

The study highlights opportunities to enhance fish consumption and market sustainability through awareness campaigns, improved infrastructure, and promotion of community-based aquaculture. Such measures have the potential to improve dietary diversity, strengthen rural

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livelihoods and contribute to the broader goals of nutritional security in Bihar.

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Conflict of Interests

The authors declare that there is no conflict of interest.

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